



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER OF PATENTS AND TRADEMARKS
Washington, D.C. 20231
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/966,605	09/28/2001	Ping Jiang	TI-31462	4769

23494 7590 04/09/2003

TEXAS INSTRUMENTS INCORPORATED
P O BOX 655474, M/S 3999
DALLAS, TX 75265

EXAMINER

VINH, LAN

ART UNIT	PAPER NUMBER
----------	--------------

1765

DATE MAILED: 04/09/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/966 605

Applicant(s)

JIANG ET AL

Examiner

Lan Vinh

Art Unit

1765

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED. (35 U.S.C. § 133)
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 26 September 2001.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-15 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-15 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☒ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449, Paper No.s _____)
- 4) ☐ Interview Summary (PTO-413, Paper No.s _____)
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other _____

DETAILED ACTION

Claim Rejections - 35 USC § 102

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

2. Claims 1-2, 4, 7, 8 are rejected under 35 U.S.C. 102(e) as being anticipated by Hung et al (US 6,380,096).

Hung discloses an in-situ oxide etch process useful for copper dual damascene.

This process comprises the steps of:

forming a low-k dielectric layer 14 over a silicon substrate 10/semiconductor body
(col 2, lines 16-19)

forming a patterned photoresist/resist layer 98 over the low-k dielectric layer 14 (col 8, lines 66-67, col 9, lines 1-2, fig. 6)

performing an etching step 144 to etch the layer 14 using the photoresist pattern 98
(col 10, lines 26-28, fig. 6)

performing a post etch treatment 146 using oxygen plasma on the exposed dielectric layer 14 (as shown in fig. 9), the treatment step 146 and the etching step 144 are performed in the same chamber (col 10, lines 49-60), which reads on treating the low-k

dielectric layer with a plasma, wherein the treating step occurs in-situ with respect to the etching step.

The limitations of using oxygen plasma, as recited in claims 2, 4, have been discussed above.

Regarding claim 7, Hung discloses that the post etch treatment strips/removes the remaining photoresist pattern (col 10, lines 48-50)

The limitation of claim 8 has been discussed above.

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

4. Claims 3 is rejected under 35 U.S.C. 103(a) as being unpatentable over Hung et al (US 6,380,096) in view of Tamaoka et al (US 6,232,237)

Hung's method has been described above in paragraph 2. Unlike the instant claimed invention as per claim 3, Hung does not disclose that the plasma treatment comprises H₂O.

However, Tamaoka discloses a method for fabricating semiconductor device comprises the step of performing a plasma treatment using H₂O to remove a resist mask/pattern (col 5, lines 23-24)

Since Hung discloses the step of etching the dielectric layer 14 to form a opening/via before the plasma treatment step, one skilled in the art would have found it obvious to modify Hung's step of plasma treatment to remove the resist by performing a plasma treatment using H₂O as per Tamaoka because Tamaoka states that by removing the resist mask using H₂O plasma, respective portions of the dielectric layer which are exposed on the inner side face of the via hole are neither adversely affected nor degraded (col 5, lines 37-41)

5. Claims 5 is rejected under 35 U.S.C. 103(a) as being unpatentable over Hung et al (US 6,380,096) in view of Lin et al (US 6,342,448)

Hung's method has been described above in paragraph 2. Unlike the instant claimed invention as per claim 5, Hung fails to disclose using the low-k dielectric of organo-silicate glass (OSG) although Hung discloses using fluorinated silica glass (FSG) as the low k dielectric material (col 2, lines 33-34)

Lin, in a method of fabricating barrier adhesion to low-k dielectric layers, teaches that a low-k dielectric layer can be formed by fluorinated silica glass (FSG) or alternately by organo-silicate glass (OSG) (col 4, lines 6-15)

Hence, one skilled in the art would have found it obvious to substitute Hung's FSG low k dielectric layer with organo-silicate glass (OSG) in view of Lin's teaching because both materials are equivalent low-k dielectric material, thus, the substitution of one for the other would have produced an expected result.

6. Claims 6 is rejected under 35 U.S.C. 103(a) as being unpatentable over Hung et al (US 6,380,096) in view of Cox (6,166,439)

Hung's method has been described above in paragraph 2. Unlike the instant claimed invention as per claim 6, Hung does not disclose using an ultra-low-k dielectric layer having a dielectric constant less than 2.5.

However, Cox discloses a method of application of low-k dielectric material comprises the step of forming a low-k dielectric material having a dielectric constant less than 2.0 (col 8, lines 48-50)

Hence, one skilled in the art would have found it obvious to modify Hung's method by using a low-k dielectric material having a dielectric constant less than 2.0/ultra-low-k dielectric material which afford for facilitating the reduction of capacitive crosstalk between the adjacent conductive lines as taught by Cox (col 8, lines 50-52)

7. Claims 9-10 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hung et al (US 6,380,096) in view of Yamazaki (6,350,701)

Hung's method has been described above in paragraph 2. Hung differs from the instant claimed invention as per claims 9-10 by performing the plasma treating step and the etching step in a same chamber instead of in separate chambers.

However, Yamazaki discloses an etching method comprises the step of performing the oxygen plasma treating step/ashing step and the etching step in separate chambers under vacuum (col 12, lines 6-32)

Hence, one skilled in the art would have found it obvious to modify Hung's method by performing the oxygen plasma treating step/ashing step and the etching step in separate chambers as per Yamazaki because according to Yamazaki, it is particularly effective in a semiconductor manufacturing process in which cleanliness of an interface between films is important by providing an etching chamber, an ashing chamber as the reaction chamber in the system (col 3, lines 10-14)

8. Claims 11-12, 14 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hung et al (US 6,380,096) in view of Lin et al (6,042,999)

Hung discloses an in-situ oxide etch process useful for copper dual damascene. This process comprises the steps of:

forming an etch stop layer 12 over a silicon substrate 10/semiconductor body (col 2, lines 16-17)

forming a dielectric layer 14 over the etch stop layer 12 (col 2, line 18, fig. 5), which reads on forming an interlevel dielectric (IDL) over the etchstop layer

forming a dielectric layer 20 over the dielectric layer 14 (fig. 5), which reads on forming an intrametal dielectric (IMD) over the IDL layer

forming a layer 94 over dielectric layer 20 (col 8, lines 60-61), which reads on forming a capping layer over the layer 20/IMD layer

forming a patterned photoresist/resist layer 98 having an opening on the layer 94/capping layer (col 8, lines 66-67, fig. 5)

Art Unit: 1765

performing an etching step 144 to etch the layers 20 and 14 using the photoresist pattern 98 as a mask (col 10, lines 26-28, fig. 6)

performing a post etch treatment 146 using oxygen plasma to strips/removes the remaining photoresist pattern (col 10, lines 48-50), the treatment step 146 and the etching step 144 are performed in the same chamber (col 10, lines 49-60), which reads on treating the low-k dielectric layer with a plasma, wherein the treating step occurs in-situ with respect to the etching step. It is noted that the applicants disclose that the cause of resist poisoning is believed to be the interaction between the resist and nitrogen-containing reagent from the low-k films in page 5 of the specification. Since Hung teaches the same step of removing the resist pattern using the same plasma treatment (oxygen) as the claimed invention, the plasma treatment is performed in the same chamber with the etching step 144 that etches a via in the same material (low-k dielectric) as the claimed invention, one skilled in the art would have found it obvious that Hung 's oxygen plasma treatment step would have reduced poisoning by a nitrogen source as the claimed plasma treatment step.

completely filling the via with an antireflection coating (ARC) material 112 (col 9, lines 15-16, fig. 7), which reads on filling the via with an organic material

forming a trench pattern 118 over layer 20/IMD layer (col 9, lines 23-24, fig. 7)

etching a trench in the layer 20/IMD layer using the pattern 118 (col 9, lines 26-28)

removing the trench pattern 118 and organic material 112 in the via (col 9, lines 31-32)

removing the layer 94/capping layer and the exposed portion of etch stop layer 12
(col 9, lines 6-8, fig. 9)

filling the via and the trench with copper to form extending interconnect (col 9, lines
45-47)

Hung differs from the instant claimed invention as per claim 11 by completely filling
the via with an organic material instead of partially filling the via with an organic
material.

However, Lin discloses a dual damascene process comprises the step of partially
filling the hole/via 145 with ARC (antireflective coating)/organic material 150 (col 5, lines
36-64, fig. 2d)

Since both Hung and Lin are concerned with a method of forming dual-damascene
structure having interconnect, one skilled in the art would have found it obvious to
modify Hung's method by partially filling the hole/via with organic material 150 as taught
by Lin because Lin teaches that the partial filling of ARC serves its purpose of protecting
the exposed substructure at the bottom of the hole/via from the damage that can be
caused by the second etching energy to form conductive pattern (col 6, lines 10-14)

The limitations of claims 12 and 14 have been discussed above.

9. Claim 13 is rejected under 35 U.S.C. 103(a) as being unpatentable over Hung et al
(US 6,380,096) in view of Lin et al (US 6,042,999) and further in view of Tamaoka et al
(US 6,232,237)

Hung as modified by Lin has been described above in paragraph 8. Unlike the instant claimed invention as per claim 13, Hung and Lin do not disclose that the plasma treatment comprises H₂O.

However, Tamaoka discloses a method for fabricating semiconductor device comprises the step of performing a plasma treatment using H₂O to remove a resist mask/pattern (col 5, lines 23-24)

Since Hung discloses the step of etching the dielectric layer 14 to form a opening/via before the plasma treatment step, one skilled in the art would have found it obvious to modify Hung and Lin by performing a plasma treatment using H₂O as per Tamaoka because Tamaoka states that by removing the resist mask using H₂O plasma, respective portions of the dielectric layer which are exposed on the inner side face of the via hole are neither adversely affected nor degraded (col 5, lines 37-41)

10. Claim 15 is rejected under 35 U.S.C. 103(a) as being unpatentable over Hung et al (US 6,380,096) in view of Lin et al (US 6,042,999) and further in view of Yamazaki (6,350,701)

Hung as modified by Lin has been described above in paragraph 8. Hung and Lin differ from the instant claimed invention as per claim 15 by performing the plasma treating step and the etching step in a same chamber instead of in separate chambers.

However, Yamazaki discloses an etching method comprises the step of performing the oxygen plasma treating step/ashing step and the etching step in separate chambers under vacuum (col 12, lines 6-32, fig. 8).

Hence, one skilled in the art would have found it obvious to modify Hung and Lin by performing the oxygen plasma treating step/ashing step and the etching step in separate chambers as per Yamazaki because according to Yamazaki, it is particularly effective in a semiconductor manufacturing process in which cleanliness of an interface between films is important by providing an etching chamber, an ashing chamber as the reaction chamber in the system (col 3, lines 10-14)

Conclusion

11. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Lan Vinh whose telephone number is 703 305-6302. The examiner can normally be reached on M-F 8:30-5:30 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Benjamin Utech can be reached on 703 308-3836. The fax phone numbers for the organization where this application or proceeding is assigned are 703 872-9310 for regular communications and 703 872-9311 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703 308-0661.



LV
April 3, 2003